To Determine Refractive Index Of a Glass Slab Using a Travelling Microscope

Aim
To determine refractive index of a glass slab using a travelling microscope.

Apparatus
Three “glass slabs of different thickness but same material, a travelling microscope, lycopodium powder. A slab is a piece of transparent material with rectangular faces. All faces are transparent and opposite faces are parallel. The dimension along with the light travels inside the slab is called its thickness.
A Short Description of a Travelling Microscope
It is a compound microscope fitted vertically on a vertical scale. It can be moved up and down, carrying a Vernier scale moving along the main scale.
In any position, the reading is taken by combining main scale and vernier scale reading.

Theory
Read Art. 9.09

From relation, $$n = \frac{\text{real thickness of slab}}{\text{apparent thickness of slab}}$$

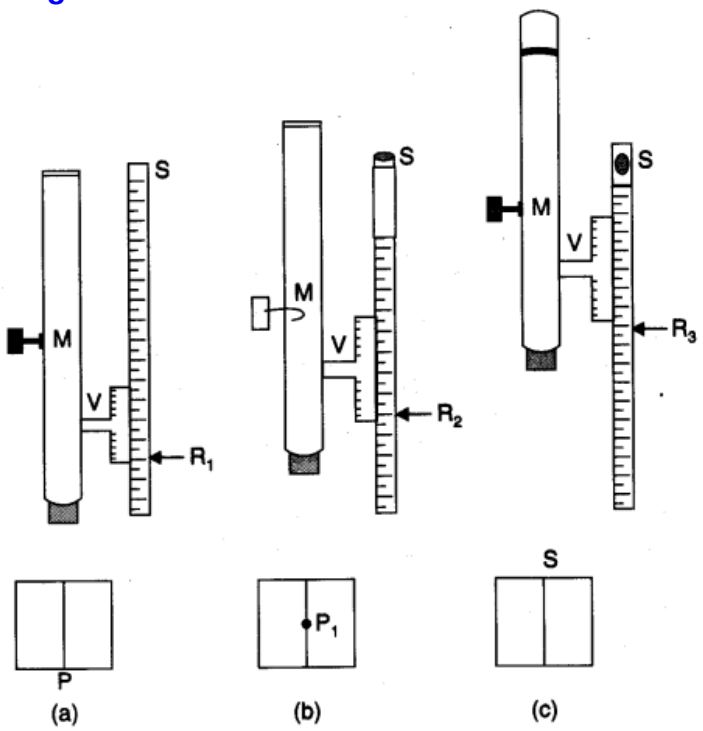
Diagram


Fig. Real and apparent thickness.

Procedure

Adjustment of travelling microscope

1. Place the travelling microscope (M) on the table near a window so that sufficient light falls on it.
2. Adjust the levelling screws so that the base of the microscope becomes horizontal.
3. Make microscope horizontal. Adjust the position of the eye piece so that the cross wires are clearly visible.
4. Determine the vernier constant of the vertical scale of the microscope.
   Other steps
5. Make a black-ink cross-mark on the base of the microscope. The mark will serve as
   point P. ,
6. Make the microscope vertical and focus it on the cross at P, so that there is no parallax between the cross-wires and the image of the mark P.
7. Note the main scale and the vernier scale readings (R_1) on the vertical scale.
8. Place the glass slab of least thickness over the mark P.
9. Raise the microscope upwards and focus it on the image P_1 of the cross-mark.
10. Note the reading (R_2) on the vertical scale as before (Step 7).
11. Sprinkle a few particles of lycopodium powder on the surface of the slab.
12. Raise the microscope further upward and focus it on the particle near S.
13. Note the reading (R_3) on the vertical scale again (Step 7).
14. Repeat above steps with other glass slab of more thicknesses.
15. Record observations in tabular form as given below.

Observations and calculations

Vernier constant (least count) for vertical scale of microscope =……cm.

Table for Microscope Readings

Serial No.	*Reading on vertical scale when microscope is focussed on*			*Real thickness* $(R_3 - R_1)$ *(cm)*	*Apparent thickness* $(R_3 - R_2)$ *(cm)*	*Refractive index* $n = \frac{R_3 - R_1}{R_3 - R_2}$
	Cross-mark without slab R_1 *(cm)*	*Cross-mark with slab* R_2 *(cm)*	*Lycopodium powder* R_3 *(cm)*			
1.						
2.						
3.						

Mean $n = \frac{n_1 + n_2 + n_3}{3}$

Result

The ratio $\frac{R_3 - R_1}{R_3 - R_2}$ is constant.

It gives refractive index of the material of the glass slab.

Precautions

1. In microscope, the parallax should be properly removed.
2. The microscope should be moved in upper direction only to avoid back lash error.

Sources of error

The microscope scale may not be properly calibrated.

Viva Voce

Question. 1. Define a slab.
Answer. Read Art. 9.07.

Question. 2. Define thickness of a slab.
Answer. Read Art. 9.07.

Question. 3. Define lateral displacement.
Answer. Read Art. 9.09.

Question. 4. Why a slab does not deviate and disperse light, where as a prism does?
Answer. In a slab, the refracting faces are parallel. The emergent ray is parallel to the incident ray. There is no deviation and dispersion.
In a prism, the refracting faces are not parallel. The emergent ray is not parallel to incident ray. There is a deviation and hence dispersion.

Question. 5. Why lycopodium power is spread over the glass surface?
Answer. To focus the microscope accurately, otherwise the bottom surface will be focused because of transparency of glass slab.

Question. 6. What is normal shift?
Answer. It is the difference between actual depth and apparent depth. Its S.I. unit is metre.

Question. 7. What is cause of normal shift?
Answer. Due to refraction of light.

Question. 8. On what factors, apparent depth depends?
Answer.

1. nature of medium (R.I.)
2. thickness of medium (actual depth)
3. colour of light.

Question. 9. In general for which colour we take the refractive index of a material in lens and glass slabs.
Answer. Yellow colour. Since it is the mean colour of visible spectrum.

Question. 10. What may be refractive index for hollow glass slab?
Answer. n = 1.